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L4: Entry 37 of 45

File: USPT

Jan 4, 1977

DOCUMENT-IDENTIFIER: US 4001691 A

TITLE: Communications relay system

## DEPR:

FIG. 9 shows a system over view for a distribution communication system for a typical local area. Subscribers 100, 101 and 102 communicate with each other through a transponder 103 which serves as a relay and repeater. In this embodiment, the subscribers are assigned time slots with a typical main timing diagram for the channel distribution being shown in FIG. 10. Subscribers who are to communicate with each other are assigned a common time slot or channel such as subscriber 100 who communicates with subscriber 101 and is assigned channel 1.

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L4: Entry 28 of 45

File: USPT

Apr 23, 1985

DOCUMENT-IDENTIFIER: US 4513416 A

TITLE: System for adjusting a time axis by using a control and an adjustment time slot in a satellite station of a TDMA network

DEPR:

It will now be surmised that the speech time slot assigned to the selected station in the upward frame has the same ordinary number as the speech time slot assigned thereto in the downward frame. The network is designed so that the burst signal sent at one of the satellite stations 12's in immediate response to the burst signal sent at the central station 11 may reach the latter with a frame delay  $t_{sub.e}$  prescribed in consideration of operation in the most distant one of the satellite stations 12's and in, if any, the repeater station or stations connecting that satellite station with the central station 11. In any event, the response delay  $t_{sub.x}$  should be equal to the frame delay  $t_{sub.e}$  minus twice the propagation delay  $t_{sub.d}$ . The satellite stations 12's are capable of adjusting their respective time axes so as to achieve the correct timing.

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L3: Entry 49 of 57

File: USPT

Dec 27, 1988

DOCUMENT-IDENTIFIER: US 4794649 A

TITLE: Radio communication system with power saving disablement prior to call handling processes

## ABPL:

A radio communication system comprises a base station for periodically transmitting a power saving signal and an information signal, a repeater station for relaying the signals, and a plurality of terminal stations for communicating with the base station through the repeater station. The repeater station includes power saving circuitry which responds to the power saving signal by cutting off power supplies to its major power consumptive components during a preset interval which alternates with an active interval during which power is supplied to the components. Each terminal station includes power saving circuitry responsive to the power saving signal relayed by the repeater station to cut off power supplied to its major power consumptive components during the preset interval and power saving disabling circuitry for transmitting a power saving disabling signal to the repeater station during the active interval in response to a request for call and disabling its power saving circuitry for the duration of the preset interval. The repeater station responds to the power saving disabling signal from a terminal station to disable its power saving circuitry for the duration of the preset interval to thereby permit the information signal to be relayed to the terminal station which has transmitted the power saving disabling signal. The terminal station then transmits a call request signal to the repeater station to permit it to be handled during the interval in which power saving is disabled.

## BSPR:

Periodic interruption of power supplies to the major power consumptive units of repeater and terminal stations of a radio communication system such as TDMA (time-division multiple access) radio concentrator systems, is a scheme known as power saving. Power saving of this type is essential to the operation of radio communication stations located at remote, thinly populated areas or emergency radio communication stations which rely on storage batteries. As shown and described in U.S. Pat. No. 4,577,315 issued to S. Otsuka, a power saving signal is constantly transmitted at periodic intervals from a base station and relayed by repeater stations to remote, terminal stations to cut off their power consumptive components for a preset time interval. However, origination of a call requires transmission of a long packet of data from terminal stations during an active interval of the system to request the base station to issue a series of signals according to protocols. In the disclosed prior art system, the transmission of a call origination request signal results in the disablement of power saving in the repeater and terminal stations to permit them to process the signals. Because of the lengthy packet in relation to the limited time interval during which transmission must be complete, call origination attempts from terminal stations tend to concentrate during the limited time interval and encounter data collision. When the transmitted data is destroyed by partial data overlap, the base station would generate a series of protocols, resulting in fruitless data exchanges along the network causing a systemwide traffic congestion.

## BSPR:

The above object is obtained by transmitting a disabling signal during the limited active period from a terminal station to a repeater station prior to the transmission of a call request signal. The disabling signal disables the power saving operations of the repeater station and the own terminal station and allows the latter to receive signals relayed through the active repeater station and send a call request signal to it so that a series of call processing signals can be handled during the power saving disabled period. Since the power saving disabling signal can be a short packet of data and induces no protocol actions in the base station, its probability of encountering collision is very slight and

hence a systemwide traffic congestion cannot occur even if data collision occurs. Preferably, the power saving disabling signal is transmitted after a randomly determined period of time following a transition from an inactive period to an active period. In a further preferred form of the invention, the terminal station is arranged to transmit a call request signal after a randomly determined period following the reception of a signal relayed by the repeater station which is rendered active in response to the disabling signal.

BSPR:

Specifically, a radio communication system of the invention comprises a base station for transmitting a power saving signal and an information signal, a repeater station for relaying the signals, and a plurality of terminal stations for communicating with the base station through the repeater station. The repeater station includes power saving circuitry responsive to the power saving signal to cut off power supplies to its major power consumptive components during a preset interval which alternates with an active interval during which power is supplied to the components. Each terminal station includes power saving circuitry responsive to the power saving signal relayed by the repeater station to cut off power supplies to its major power consumptive components during the preset interval and power saving disabling circuitry for transmitting a power saving disabling signal to the repeater station during the active interval in response to a request for call and disabling its power saving circuitry for the duration of the preset interval. The repeater station includes power saving disabling circuitry which is responsive to the power saving disabling signal from a terminal station to disable its power saving circuitry for the duration of the preset interval to thereby permit the information signal to be relayed to the terminal station which has transmitted the power saving disabling signal. Each terminal station transmits a call request signal to the repeater station to thereby permit it to be handled during the interval in which power saving is disabled.

DRPR:

FIG. 2 is a block diagram of a base station;

DRPR:

FIG. 3 is an illustration of the format of data transmitted constantly from the base station;

DRPR:

FIG. 4 is a block diagram of a repeater station;

DEPR:

As represented in FIG. 1, a time division multiple access (TDMA) radio concentrator system of the invention comprises a base station 10 connected to subscriber line terminals of an end office switching system 11 of the public telecommunication network, repeater stations 12 and 13 and terminal stations 14 and 15 which are located in remote, thinly populated areas. Terminal stations 14 are located in an area that is appropriate for establishing communications with the repeater station 12 and terminal stations 15 are located in another area appropriate for communications with the repeater station 13. All the terminal stations 14 and 15 have their corresponding subscriber line terminals at the end office switching system 11. As viewed from the end office switching system, the base station 10 provides line concentration by switching the subscriber lines to a smaller number of "downstream" TDMA channels and as viewed from the terminal stations it provides deconcentration by switching the "upstream" TDMA channels to the subscriber lines. Each terminal station has connected to it a subscriber station such as telephone and telefax machine. All the repeater and terminal stations operate on individual battery supplies.

DEPR:

In FIG. 2, the base station comprises a line concentrator 20, a plurality of PCM codecs (coder/decoders) 21 provided in number corresponding to the number of two-way TDMA channels and a time slot controller 22. Time slot controller 22 is associated with each of the codecs 21, concentrator 20, radio transmitter 23 and radio receiver 24. Each codec 21 has a hybrid, a PCM coder for encoding an outgoing analog signal coupled through the hybrid from the concentrator 20 and applying the encoded outgoing signal on a specified outgoing time slot to transmitter 23 and a PCM decoder for decoding an incoming digital signal from receiver 24 on a specified incoming time slot and applying the decoded signal

through the hybrid to the concentrator 20. Transmitter 23 modulates a carrier with the TDM bit stream using a digital modulation technique and amplifies the modulated carrier to a level sufficient for transmission, the output of transmitter 23 being coupled through duplexer 25 to antenna 26. Receiver 24 amplifies and demodulates a digitally modulated RF signal received by antenna 26 to recover baseband TDM signals.

DEPR:

As illustrated in FIG. 3, time-slot controller 22 generates a timing reference to permit each codec to determine a particular one of the time slots TS0 to TS<sub>n</sub> of a "frame". Time slot TS0 comprises a plurality of "fields". The first field contains a preamble from which the receiving stations recover clock signals. Typically, the preamble consists of a series of 16 bits of alternating binary 1's and 0's. A frame sync code, which is also a 16-bit series of a unique code format (typically, "1010010100110110"), is inserted to the second field of the time slot TS0. A battery saving (BS) code is inserted to the third field of the first time slot and is followed by a control field in which signaling and time slot assignment information is inserted. The BS code determines the timing reference with which all the repeater and terminal stations are synchronized to cut off their battery supplies at periodic intervals to conserve their power. The BS code comprises "1010" (BS-ON) for power cut-off and "0101" (BS-OFF) for power restoration. To achieve most efficient power savings, frames containing the BS-ON code are repeated so as to continue for a period of time much longer than the period in which frames having the BS-OFF code continue. As will be described later, the frames containing the BS-ON code are termed "D-frames" and those containing the BS-OFF code are termed "C-frames". The time slot TS0 is followed by a series of information carrying time slots TS1 to TS<sub>n</sub> each having a 16-bit time-slot sync having a bit pattern "101001010011011" which differs from the frame sync in that the least significant bit is a binary 1. The time slots TS1 to TS<sub>n</sub> correspond respectively to the codecs 21. A consecutive series of power-cutoff D-frames alternates with a consecutive series of power-restoration C-frames and transmitted from the antenna 26 on a broadcast mode through repeater stations 12 and 13 to all terminal stations 14 and 15.

DEPR:

FIG. 4 illustrates details of each repeater station. The broadcast time-division multiplexed signal is intercepted by an antenna 30 and applied through duplexer 31 to a radio receiver 32 and applied on a "downstream" signal transmission path including a delay 33 and a gate 34 to a radio transmitter 35 whose output is coupled through duplexer 36 to antenna 37. Burst signals transmitted on assigned time slots from the associated terminal station are received by antenna 37, passed through duplexer 36 to a radio receiver and applied on an "upstream" signal transmission path including a delay 39 and a gate 40 to a radio transmitter 41 and thence to duplexer 31. Receivers 32, 38 and transmitters 35 and 41, which are the main power consumptive components of the repeater station, are powered from a power source, or storage batteries 42 through normally open contacts of a power-saving switch 43 which is controlled in a manner as will be described.

DEPR:

Receiver 32 amplifies the downstream radio-frequency TDM signal and demodulates it to recover the baseband TDM signal. The output of receiver 32 is applied to a clock recovery circuit 44, a sync detector 45 and a BS detector 46. Clock recovery circuit 44 detects a preamble from the received bit stream to recover clock timing and supplies clock pulses to sync detector 45 and BS detector 46. Sync detector 45 essentially comprises a shift register which is clocked by the clock recovery circuit 44 to accept the output of receiver 32 and a digital comparator which compares the binary states of the loaded data bit stream with the code format of the sync and generates an equality output when they match, this output being applied as a trigger signal to a monostable multivibrator 47 and as an enabling signal to the BS detector 46. The downstream TDM output of receiver 32 is timed by delay 33 so that it passes to the transmitter 35 through gate 34 in response to a gate-on pulse from the monostable 47. Transmitter 35 modulates the output of gate 34 upon a carrier frequency different from the carrier frequency transmitted from the base station and applies it through duplexer 36 to antenna 37. The BS detector 46 is constructed in a manner similar to sync detector to detect the BS-ON code immediately following the detection of a sync code by sync detector 45. A timer 48 is connected to the output of BS detector 46 to operate the battery-saving switch 43 through an OR gate 49. Timer

48 may be formed of a monostable multivibrator and an inverter connected to the output of the monostable to generate a logical 0 output (power cutoff signal) of a duration slightly longer than the duration of a series of D-frames in response to the receipt of a single BS-ON code that occurs at the first of the series of D-frames.

DEPR:

In the "upstream" section of the repeater station, the receiver 38 amplifies the radio-frequency TDM signal from antenna 37 and demodulates it to recover the baseband TDM signal which is applied to a clock recovery circuit 50. Clock recovery circuit 50 detects a preamble from the bit stream received from the terminal stations and recovers clock timing. A sync detector 51 is synchronized to the clock pulse from the clock recovery circuit 50 and detects a sync code contained in the received TDM bit stream. The output of sync detector 51 drives a monostable multivibrator 52 to open the gate 40 to pass the TDM bit stream, which is appropriately timed by the delay 39, to transmitter 41 where it is modulated upon a particular carrier frequency and amplified for transmission to the base station. According to the present invention, a battery saving inhibit flip-flop 53 is provided. This flip-flop responds to the output of sync detector 51 by supplying a logical 1 output through OR gate 49 to switch 43 to inhibit battery saving operation and further responds to the logical 1 output (power restoring signal) of timer 48 by supplying a logical 0 output to switch 43 to allow it to open its contacts to resume battery saving operation.

DEPR:

In FIG. 6, each terminal station couples battery supplies to a receiver 60 and a transmitter 61 from a storage battery 62 through a power saving switch 63. The relayed radio-frequency TDM signal is intercepted by antenna 64 and applied through duplexer 65 to receiver 60 where it is amplified and demodulated. The output of receiver 60 is applied to the decoder input of a PCM codec 66, the encoder output of which is connected to transmitter 61. Codec 66 is connected over a subscriber line to a telephone set 67 to convert the analog speech signal into digital form and insert the digital signal to a time slot specified by a controller 68 for application to transmitter 61. Codec 66 detects a digital signal on a specified time slot of the recovered TDM baseband signal and converts it to an analog form for application to the telephone 67. A clock recovery circuit 69 derives clock timing from the preamble of the relayed bit stream and causes a sync detector 70 to detect a sync code immediately following the preamble. Sync detector 70 enables a BS detector 71 to detect a BS-ON code from the battery saving field of the bit stream. In a manner similar to the repeater station, the BS detector 71 drives a timer 72 upon detection of a BS-ON code to cause a power cutoff signal of the same duration as in the repeater station to be generated. This power cutoff signal is applied through an OR gate 73 to power saving switch 63.

DEPR:

In order to eliminate the prior art problems by reducing the chances of data collision during call setup periods, controller 68 monitors the output of timer 72 to detect a transition from an active interval (BS-OFF) to an inactive interval (BS-ON) and generates a battery saving inhibit command signal after a random time period following the detection of the transition which occurs after telephone 67 goes off hook for call origination. This BS inhibit command signal is applied to the code generator 74 to cause a BS inhibit code to be generated. This inhibit code comprises a preamble, a sync code and a dummy code as shown in FIG. 7a to be transmitted to the repeater station to inhibit its battery saving operation. This BS inhibit command signal is also applied to the set input of a battery saving inhibit flip-flop 75 to cause it to apply a logical 1 output through OR gate 73 to switch 63 to close its contacts. Flip-flop 75 is reset in response to a power cutoff signal from timer 72 to apply a logical 0 output to switch 63 to resume battery saving operation.

DEPR:

Following the transmission of a BS inhibit burst, controller 68 is conditioned to monitor the arrival of a sync code contained in a received bit stream to recognize that the battery saving operation is inhibited in the associated repeater station. On recognizing this fact, the controller 68 proceeds to apply a call request command signal to the code generator 74 after a random time period following the detection of a "downstream" sync code to cause a call request code to be generated. This call request signal comprises a preamble, a sync code and

control codes as shown in FIG. 7b. The length of this signal is much longer than the BS inhibit signal of FIG. 7a.

DEPR:

For a full understanding of the present invention, reference is now made to a time diagram shown in FIG. 8. Base station 10 constantly broadcasts a series of C-frames and a series of D-frames during alternate periods, so that power supplies are cut off in synchronism in all the repeater and terminal stations. More specifically, in each repeater station, sync detector 45 monitors the BS field of each frame. When the repeater station is in receipt of a series of C-frames, timer 48 causes a power supply signal to be applied to switch 43 to supply power to its power consumptive units. When it is receiving a series of D-frames, timer 48 switches its output state to cause a power cutoff signal to be applied to switch 43 to cut off power supplies to the power consumptive units. In a similar manner, in each terminal station, sync detector 71 monitors the BS field of each frame relayed from the associated repeater station. When the terminal station is in receipt of a series of C-frames, timer 72 causes a power supply signal to be applied to switch 63 to supply power to its power consumptive units. When it is receiving a series of D-frames, timer 72 switches its output state to cause a power cutoff signal to be applied to switch 63 to cut off power supplies to the power consumptive units.

DEPR:

Assume that a call is originated from a terminal station at time  $t_{sub.0}$  during the time the whole system is in an inactive mode. Controller 68 monitors the output of timer 72 and generates a BS inhibit command signal after a random time period  $T_{sub.1}$  following the occurrence of a power supply signal (logical 0) at the output of timer 72 at time  $t_{sub.1}$ , whereupon the system enters an active mode. The BS inhibit command signal is applied to the code generator 74 to cause a BS inhibit signal (FIG. 7a) to be applied to transmitter 61 and transmitted and received by the associated repeater station. Concurrently, the BS inhibit command causes a power-saving disablement signal (logical 1) to be supplied from flip-flop 75 through OR gate 73 to the switch 63 so that its contacts are kept closed during the period following the termination of the power supply signal from the timer 72.

DEPR:

In the repeater station, clock timing is recovered from the preamble of the received inhibit signal by the clock recovery circuit 50 and fed to the sync detector 51 to enable it to detect a sync code. Flip-flop 53 is triggered into set condition in response to the sync code, applying a power-saving disablement signal (logical 1) through OR gate 49 to switch 43 to keep its contacts closed during the period following the termination of the power supply signal from the timer 48 in a manner similar to the terminal station. At time  $t_{sub.2}$ , the "downstream" TDMA signal changes from C-frames to D-frames and timers 48 and 72 of the repeater and terminal stations change their outputs to logical 0. Therefore, the other repeater station and terminal stations enter an inactive mode at time  $t_{sub.2}$ . On the other hand, due to the presence of the power saving disablement signals at the outputs of flip-flops 53 and 75 of the stations exchanging the BS inhibit signal, their power saving modes are disabled regardless of the arrivals of successive BS-ON codes. By virtue of the resetting of the D-flip-flop 59, such BS-ON codes produce no adverse effect on the timing action of timer 48. The same applies to the timer 72 of terminal station. As a result, their timing outputs change to logical 0 level at time  $t_{sub.3}$  following the next transition from D-frames to C-frames.

DEPR:

After transmission of a BS inhibit signal, the controller 68 of the terminal station is conditioned to monitor the output of sync detector 70. If it detects a sync code from the "downstream" TDMA signal at time  $t_{sub.2}$ , the controller 68 recognizes that the repeater station is still active and initiates measurement of the length of time elapsed from time  $t_{sub.2}$ . When a randomly determined amount of time  $T_{sub.2}$  is reached, the controller 68 issues a call request command to the code generator 74 to cause a call request signal (FIG. 7b) to be transmitted and received by the repeater station and relayed to the base station 10 to permit it to handle the call request signal during the time period in which the repeater and terminal stations concerned would otherwise remain inactive. This power saving disablement expires at time  $t_{sub.3}$  and the whole system again enters an active state to allow various stations to reinitiate call handling actions. It is

to be noted that the BS inhibit signal requires no protocol operation. Thus, collision of a BS inhibit signal does not result in a system failure. Since the call request signal is processed when power saving is disabled and this interval is much longer than the active interval, there is a freedom of choice for the determination of the time at which the call request signal can be transmitted. Since the call request signal has a long wordlength which implies a high likelihood of data collision and this type of signal induces protocol operations in the base station, data collision of the call request signal would result in transmissions of meaningless data bits causing a systemwide traffic congestion. However, the freedom of choice allowed for the transmission of the call request signal serves to avoid data collision and hence systemwide congestion. Furthermore, the BS inhibit signal and call request signal are transmitted at randomly determined times T.sub.1 and T.sub.2, there is a very slight chance of collision with signals transmitted from other stations. To further decrease the chance of data collision, it is preferred that such signals be transmitted in succession at random times.

CLPR:

4. A radio communication system as claimed in claim 1, wherein the power saving means of said repeater station comprises:

CLPR:

9. A radio communication system as claimed in claim 6, wherein the power saving means of each of said repeater stations comprises:

CLPR:

11. A power saving method for a radio communication system, wherein the system comprises a base station connected to a telecommunication switching system, a repeater station for relaying said signals, and a plurality of terminal stations for communicating through said repeater station with said base station,

CLPV:

a base station for transmitting a power saving signal and an information signal at periodic intervals;

CLPV:

a repeater station operating alternately between a preset interval and an active interval for relaying said power saving and information signals during said active interval, said repeater station including power saving means responsive to said power saving signal to cut off power supplies to major power consumptive components thereof during said preset interval, and power saving disabling means; and

CLPV:

a plurality of terminal stations operating alternately between said preset interval and said active interval for communicating through said repeater station with said base station, each of said terminal stations including power saving means responsive to said power saving signal relayed by said repeater station to cut off power supplies to major power consumptive components thereof during said preset interval, and power saving disabling means for transmitting a power saving disabling signal to said repeater station during said active interval in response to a request for call and disabling said power saving means thereof for the duration of said preset interval,

CLPV:

said power saving disabling means of said repeater station being responsive to said power saving disabling signal from said terminal stations for disabling said power saving means thereof for the duration of said preset interval to thereby permit said information signal to be relayed to the terminal station which has transmitted said power saving disabling signal, and

CLPV:

each of said terminal stations including means responsive to said relayed information signal for transmitting a call request signal to the repeater station to thereby permit said call request signal to be relayed by the repeater station during the preset interval immediately following the transmission of said power saving disabling signal.

CLPV:

detector means for detecting said power saving signal relayed by said repeater station; and

CLPV:

a base station for transmitting a power saving signal and an information signal at periodic intervals;

CLPV:

a plurality of repeater stations operating alternately between a preset interval and an active interval for relaying said power saving and information signals, each of said repeater stations including power saving means responsive to said power saving signal to cut off power supplies to major power consumptive components thereof during said preset interval, and power saving disabling means;

CLPV:

a plurality of terminal stations operating alternately between said preset interval and said active interval for communicating through said repeater station with said base station, each of said terminal stations including power saving means responsive to said power saving signal relayed by an associated one of said repeater stations to cut off power supplies to major power consumptive components thereof during said preset interval, and power saving disabling means for transmitting a power saving disabling signal to said associated repeater station during said active interval in response to a request for a call and for disabling the power saving means thereof for the duration of said preset interval,

CLPV:

the power saving disabling means of each of said repeater stations being responsive to said power saving disabling signal from the terminal stations for disabling the power saving means thereof for the duration of said preset interval to thereby permit said information signal to be relayed to the terminal station which has transmitted said power saving disabling signal,

CLPV:

each of said terminal stations including means responsive to said relayed information signal for transmitting a call request signal to the associated repeater station to thereby permit said call request signal to be relayed by the associated repeater station during the preset interval immediately following the transmission of said power saving disabling signal.

CLPV:

detector means for detecting said power saving signal relayed by said repeater station; and

CLPV:

transmitting from said base station a power saving signal and an information signal so that said signals are relayed by said repeater station to said terminal stations;

CLPV:

effecting a power saving operation by cutting off power supplies to major power consumptive components of said repeater station and said terminal stations in response to said power saving signal during a preset interval which alternates with an active interval;

CLPV:

transmitting from one of said terminal stations a power saving disabling signal to the repeater station during said active interval in response to a request for call;

CLPV:

disabling said power saving operation of said one terminal station and said repeater station for the duration of said preset interval to thereby permit said information signal to be relayed to said one terminal station; and

CLPV:

detecting the information signal relayed by the repeater station to said one terminal station and transmitting therefrom a call request signal to said repeater station to permit the call request signal to be relayed to said base

station and processed during the preset interval which follows the transmission of said power saving disabling signal.

**WEST**☐ Generate Collection

L3: Entry 12 of 57

File: USPT

Jul 27, 1999

DOCUMENT-IDENTIFIER: US 5930297 A  
TITLE: Base station emulator

**ABPL:**

A wireless digital telephone system containing at least one emulated base station plus one or more subscriber stations, the emulated base station comprising a station similar to the subscriber station but having the capability of initiating a synchronization process whereby it is enabled to assign time slots to the subscriber station within the frame pattern of an amplitude signal by means of monitoring for positive edges in the signal.

**BSPR:**

In general, present day telephone systems are increasingly using wireless technology for long distance calls and, in some instances, have begun the use of digital technology; however, no system in general use today has been capable of providing effective and efficient wireless digital technology for local calls to and from individual subscribers. Such technology has been disclosed in various recent patents commonly owned by the present applicants' assignee, as, for example, in U.S. Pat. No. 4,644,561, dated Feb. 17, 1987 and U.S. Pat. No. 4,675,863, dated Jun. 23, 1987. The technology disclosed in these patents provides base stations in communication with both a central office and a plurality of subscriber stations utilizing digital wireless time division circuits wherein there are repetitive sequential slot positions in a transmit channel bit stream/ each slot being associated with a particular subscriber.

**BSPR:**

The base stations used in the above time division system are relatively complex and expensive but economically feasible for a large system serving a large number of subscribers; however, for relatively small systems serving a relatively small number of subscribers it may be economically infeasible. In addition, such a system utilizes a pair of frequencies, one for transmission and one for reception, and, in view of the limited amount of channels available in the spectrum, it would be highly advantageous if only one frequency could be effectively used.

**BSPR:**

It is, therefore, an object, of the present invention to provide what may be called a simulated or emulated base station which can be effectively substituted for an actual base station in certain situations.

**BSPR:**

Another object is to provide a system that can be utilized for plural subscribers but which is operable on only a single frequency.

**BSPR:**

In essence, the system of the present invention utilizes what is, in effect, a modified subscriber station to act as a simulated or emulated base station, thereby considerably decreasing the total cost and complexity of the system. This emulated base station essentially differs from the subscriber station only in being able to initiate the synchronization process, whereas the subscriber unit only acts to scan the RF signals sent out by the emulated base station until it finds the frequency and slot assigned to it. In the intervals between transmissions of the RF signals the emulated base station is adapted to receive RF signals from the subscriber units. In this manner, the subscriber unit may either talk to the emulated base station which then acts as another subscriber station, or it may talk to another subscriber station that has been synchronized

therewith by the emulated base station.

DRPR:

FIG. 2 is a diagrammatic illustration of the RCC waveform used in the standard base station.

DRPR:

FIG. 9 is a diagrammatic illustration similar to FIG. 8 but showing a dual subscriber system.

DRPR:

FIG. 10 is a diagrammatic illustration of the frame format of the dual subscriber system of FIG. 9.

DRPR:

FIG. 11 is a diagrammatic illustration of the frame format of a plurality of dual subscriber systems.

DRPR:

FIG. 13 is a diagrammatic illustration of a repeater system embodying the present invention.

DRPR:

FIG. 14 is a diagrammatic illustration of a system embodying the present invention utilizing multiple repeaters.

DRPR:

FIG. 15 is a diagrammatic illustration of a system embodying the present invention where a single repeter is used to drive a plurality of other repeaters as well as subscriber units.

DEPR:

In the intervals between transmissions of the RF signals, the unit is adapted to receive RF signals from a subscriber unit. The radio 26 downconverts each of these RF signals to an IF signal and feeds this IF signal to the modem 20 via line 32. The modem 20 demodulates the IF signal to form a digital signal which is then fed to the speech processor via switch 24 and line 36. The speech processor thereupon acts to expand the signal to a digitized speech signal and this digitized signal is then fed into the codec 16 which outputs an analog speech signal to the telephone 12 via the telephone interface 14.

DEPR:

The modem 20 and radio 26 are both coupled to a control unit 44. The control unit 44 includes selecting means 45, monitoring means 46 and assigning means 47. The control unit 44 is initially set to a predetermined slot, modulation and training mode for the modem and to a predetermined RF frequency and power level for the radio. However, these parameters can be adjusted by the subscriber unit in the event they are not adequate to provide a satisfactory reception at the subscriber station.

DEPR:

In a system utilizing an actual base station, such as, for example, the system described in the aforesaid U.S. Pat. No. 4,675,863, the transmitted waveform is divided into a multiplicity (i.e. 45) msec. frames. Each frame is, in turn, divided into four 11.25 msec. slots. The base station transmits on all four slots to produce a 100% duty cycle modulation waveform, the lone exception being the radio control channel (RCC). The RCC slot is slightly shorter than 11.25 msec and this causes a small gap in the modulation at the beginning of every frame. This gap is known as an AM hole. A diagram of the waveform of the RCC channel in the actual base station format is shown in FIG. 2. In the system of the present invention, however, there is no transmission of a 100% duty cycle waveform. Instead, there is a transmission on only one slot per frame (a 25% duty cycle waveform), as shown in FIG. 3. This modified frame format necessitates changes in coarse synchronization, automatic gain control (AGC) and frequency acquisition. These changes are indicated in the following description:

DEPR:

Since the system of the present invention utilizes only a 25% duty cycle waveform, it monitors the amplitude of the received signal and searches for

positive edges in the amplitude signal. These positive edges are illustrated in FIG. 4. The subscriber unit adjusts its frame timing to align with the occurrence of these positive edges.

DEPR:

The calls are set up by a voice code word (VCW) at the beginning of every voice slot, this code word indicating an off-hook condition at the initiating station. When this occurs, the station acting as an emulated base station then appears to itself go off-hook to the central office (CO) thereby making a connection to the central office. The initiating subscriber station then proceeds to complete the call by dialing the desired number. When the initiating subscriber unit goes on-hook, the emulated base station is so informed by the VCW and presents an on-hook appearance to the central office.

DEPR:

When the emulated base station detects a ring signal from the central office, the subscriber unit is caused to ring by means of the corresponding VCW from the emulated base station. When the subscriber unit thereafter goes off-hook, the emulated base station is so informed via the corresponding VCW and it then presents an off-hook appearance to the central office.

DEPR:

The above type of wireless phone system configuration is exemplified in FIG. 8 where the subscriber unit 90 is shown in wireless communication via antennas 92 and 94 with the emulated base station 96. The station 96 is in wireline communication via line 98 and interface 100 with the central office.

DEPR:

The above-described system can be employed with a dual subscriber arrangement as shown in FIG. 9. In this system each channel is capable of supporting two complete conversations without the necessity of using a duplexer. In this respect, a dual subscriber unit 102 is connected by wires 104 and 106 to a pair of subscriber telephone sets 108 and 110. The subscriber unit 102 is in wireless communication via antennas 112 and 114 with an emulated dual base station 116. The unit 116 is connected to the central office by wire lines 118 and 120.

DEPR:

The two separate subscribers 108 and 110 utilize a time slot arrangement, such as disclosed in the aforesaid U.S. Pat. No. 4,675,863, wherein each subscriber is assigned a separate slot. The frame format for this arrangement is shown in FIG. 10 where four slots are shown, numbered 1, 2, 3 and 4. The first two slots are used for the emulated base station and the last two are used for the two subscribers.

DEPR:

A plurality of dual subscriber systems may be operated on different channels without duplexers by synchronizing all of the emulated base station transmissions. This is illustrated by the frame format shown in FIG. 11 where channel 1 is shown above and channel n (indicating any desired number of channels in between) is shown below. On each channel, the first two slots are for transmission and the last two are for reception.

DEPR:

One emulated base station may be used with a plurality of different subscribers, one at a time. In such arrangement, for reception, the subscribers continuously monitor the transmissions of the radio control channels (RCC), described more fully in the aforesaid U.S. Pat. No. 4,675,863, until a particular subscriber is paged by the emulated base station by means of the subscriber's ID Number (SID). After receiving a page, the subscriber initiates a transmission back to the emulated base station using the synchronization process described above. For initiating a call, the subscriber transmits on the RCC using the previously described synchronization process.

DEPR:

The present system may be used for monitoring one or more functions. In this respect, using a computer as a controlling/data logging device, a plurality of subscribers may be periodically polled to report on some function such as temperature, weather conditions, security, water/flood warnings, low fuel warnings, remote gas, electric or water meter readings, etc. This is illustrated

in FIG. 12 where an emulated base station 122 is in wireless communication with a plurality of subscriber units respectively designated 124, 126 and 128. The unit 122 is in wire line connection with both a telephone 130 for voice communication and a computer or data terminal 132 for data input. Similarly, each subscriber unit is connected both to a respective telephone 134, 136 or 138 for voice communication and to a data device, as at 140, 142 or 144 respectively.

DEPR:

An important use of the present system is as a repeater to extend the range of the system. In this arrangement, the emulated base station may be used to overcome interfering obstacles such as mountains and the like. FIG. 13 illustrates this function, showing a subscriber unit 146 in wireless communication with an emulated base station 148 on the summit of a mountain. The unit 148 is also in wireless communication with a standard base station 150 connected to a central office.

DEPR:

The relative simplicity and inexpensiveness of the emulated base station makes it very cost effective as a repeater unit. It can also be used as a repeater to extend the long distance range of the system regardless of the presence or absence of obstructions. By utilization of the time slot arrangement, the repeater unit, without the use of any duplexer, fits into the complete system while remaining transparent to both the standard base station and the subscriber. It can, of course, also be interposed between the subscriber and another emulated base station instead of a standard base station. This can be provided in multiple stages from one emulated base station to another to greatly increase the range of the system in a relatively inexpensive manner. This is illustrated in FIG. 14 where a series of repeater units 152 are interposed between the subscriber 154 and the base station 156.

DEPR:

In addition to extending the range of the system, the repeater unit serves to clean up the actual base station signal via equalization before retransmission to the subscriber.

DEPR:

One repeater can also be used in what may be termed a repeater star system to drive multiple repeaters and/or subscribers. This is illustrated in FIG. 15 where the single repeater unit 158 is in wireless communication with ancillary repeaters 160 and 162 as well as with one or more subscribers such as at 164. The ancillary repeaters are themselves in wireless communication with subscribers such as shown at 166, 168, 170, 172 and 174 as well as with other ancillary repeaters such as at 176. Any one of the ancillary repeaters, such as repeater 162, may be used as the final repeater in direct communication with the base station indicated at 178.

DEPR:

Multiple repeaters may be placed at one location, on different channels and synchronized so that their transmissions and receptions occur simultaneously, thereby avoiding the use of duplexers. In such a configuration, a master repeater is used to monitor the RCC channel of the base station and relays the monitored information to the various subscribers via the emulated base station's RCC. In such a configuration, on call setup, the subscribers are each assigned a repeater channel.

DEPL:

Dual Subscriber System

DEPL:

Repeater System

CLPV:

means for receiving the synchronization information from the primary station and for identifying said assignment of time slots for reception of said TX information signal and transmission of said corresponding RX information signal of said first bidirectional communication;

CLPV:

means for receiving the synchronization information from said primary station and

for identifying the assignment of time slots on said selected frequency for said bidirectional communications;

CLPV:

means for receiving a plurality of said TX information signals of said plurality of communications on said selected frequency in a first plurality of said assigned time slots; and

CLPV:

means for transmitting a plurality of said corresponding RX information signals of said plurality of communications on the selected frequency in a second plurality of said assigned time slots.

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L4: Entry 45 of 45

File: DWPI

Feb 4, 1987

DERWENT-ACC-NO: 1987-031010

DERWENT-WEEK: 198705

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TITLE: TDMA radio-communication system with time-slot detector - has data transmission authorised only when time slots are identical in both directions of communication

## ABTX:

The communication system comprises a base station with a number of repeater stations for sequentially repeating a radio signal received by and transmitted from the base station. A number of terminals communicate the radio signals with the base station via the repeater stations. Each of the repeater stations includes a repeater device for repeating the radio signal using a time slot assigned to each of the terminals.

## ABEQ:

A time division multiple access radio communication system comprising one base station (4); a plurality of repeater stations (5,6) for sequentially repeating a radio signal to be received by or transmitted from said base station; and a plurality of terminals (5',6') for communicating the radio signal with said base station via said repeater stations, each of said repeater stations including repeater means for repeating the radio signal using a time slot assigned to each of said terminals, characterised in that each of said repeater stations further comprises means (22) for detecting a time slot in upward communication, and means (14,25) for activating said repeater means only when a time slot in downward communication corresponds to the detected time slot in upward communication. (9pp)

## ABEQ:

Each of the repeater stations includes a repeater for repeating the radio signal using a time slot assigned to each of the terminals. Each of the repeater stations further detects a time slot in upward communication, and activates the repeater in association with only a time slot in downward communication corresponding to the detected time slot in upward communication. (8pp)u

**WEST**☐ Generate Collection

L4: Entry 38 of 45

File: USPT

Apr 22, 1975

DOCUMENT-IDENTIFIER: US 3879581 A

TITLE: Processing repeater for TDMA communication system

## DEPR:

The uplink frame period is divided into a number of individually assignable time slots. The wideband uplink frame format, shown in FIG. 2a, consists of a composite of non-overlapping transmission bursts from the active data terminals in the system. The format is configured to contain 800 time slots, each time slot being employed for a single transmission burst. This corresponds to 400 two-way voice or data circuits comprising two adjacent time slots. Since the data sample rate is assumed to be 8000 samples per second and the number of accumulated data samples is assumed to be 16, the uplink frame period is 2000 microseconds (i.e., 16 .times. 125 microseconds). A time slot duration is therefore 2.5 microseconds (i.e., 2000 .div. 800 microseconds). Each data transmission burst time slot, as shown in FIG. 2b, consists of a preamble 210 and 16 accumulated 8-bit PCM data samples 220. The number of bits employed for the preamble is 40. The call request portion 230 of the preamble is used to make a call request whenever a terminal 110 has one or more active channels and wishes to place another call. The preamble 210 also includes guard time 231 (required to maintain adequate separation between transmission bursts from different ground terminals 110), carrier acquisition time 232, bit acquisition time 233, and a unique word 234 used in the synchronization maintenance process and for determining the first bit of data. Since the data burst contains the equivalent of 168 bits and the time slot duration is 2.5 microseconds, the wideband uplink bit rate is 67.2 Mbps. Each fine sync code transmission burst, as shown in FIG. 2c, consists of guard times 240 and 241, carrier acquisition time 242, bit acquisition time 243, and fine sync code 244. The fine sync code transmission, which is required only during initial synchronization of a terminal, provides the spacecraft's processing repeater with the raw data for measuring the initial fine sync error. A 31-bit pseudo-noise (PN) sequence is chosen for the fine sync code 244. The spacecraft detection algorithm allows three bit errors in the code which, in conjunction with a code length of 31 bits, provides a theoretical false alarm rate of approximately one call in 39,200 and a miss rate of one call in 8,500, assuming a bit error probability of 1 .times. 10.<sup>-5</sup>. The 117-bit total guard time 240 and 241 allows a .+- . 0.85 microsecond tolerance for the coarse error measurement.

## DEPR:

The INITIAL SYNCHRONIZATION process first utilizes the wideband downlink and the narrowband uplink to achieve coarse synchronization, then the wideband downlink and wideband uplink to achieve fine synchronization. After a particular terminal 110 detects, through the control field 260 of the downlink format, that it is being interrogated or called, the terminal desiring to place a call or being called responds with a coarse sync signal through the 100 kHz bandwidth narrowband uplink 123. The coarse sync signal format is shown in FIG. 3. The first 125 microseconds provides adequate time for narrowband uplink carrier acquisition, and the signal transition 300 provides timing information for the coarse synchronization measurement. The spacecraft's processing repeater detects the occurrence of the coarse synchronization signal transition 300 and measures the time interval between the transition occurrence and the next downlink start-of-frame (i.e., incremental coarse sync error measurement). The provision in the S.<sup>2</sup> TDMA system of a narrowband uplink 123 in addition to the wideband uplink 122 allows the terminal 110 to transmit at full power high signal-to-noise ratio through the narrowband uplink 123. Since the transmitter power at the terminal is such as to assure a wideband uplink ratio of energy per bit to one-sided noise spectral density (E.<sub>b</sub>/N.<sub>0</sub>) of +10 dB at the input to the spacecraft's 4-phase burst demodulator (to attain a bit error rate of approximately 10.<sup>-5</sup>), the signal-to-noise ratio of the 100 kHz bandwidth coarse sync signal transmitted at the same power level is approximately +38 dB at

the input to the 2-phase burst demodulator. This relatively high signal-to-noise ratio assures the detection of the coarse sync signal with enough precision (3-sigma accuracy better than  $\pm 0.8$  microseconds) to eliminate the need for a statistical averaging process. Having completed the measurement, the spacecraft's processing repeater provides the digitized coarse sync error measurement and an uplink time slot assignment to the terminal 110 through the control field 260 of the wideband downlink.

**DEPR:**

After it receives its coarse sync error measurement and assigned time slot, the terminal 110 transmits a fine sync code in its assigned time slot. The fine sync code burst format as shown in FIG. 2c includes a total guard time of 117 bits. Since the transmission of fine sync code requires approximately 0.76 microseconds and the time slot duration is 2.50 microseconds, the digitized coarse synchronization error measurement accuracy must actually be better than  $\pm 0.87$  microseconds, in order that the fine sync code transmission not interfere with data transmissions from other terminals. The spacecraft's processing repeater detects the occurrence of the fine sync code within a window about the assigned time slot and measures the fine sync error. The fine sync error is determined within  $\pm 1$  uplink bit times. The processing repeater then transmits the digitized fine sync error measurement to the terminal through the wideband downlink. Upon receipt of the fine sync error, the terminal is ready for wideband uplink communication with a synchronization accuracy of  $\pm 1$  uplink bit time.

**DEPR:**

The communication processor 440 is unique to the S.sup.2 TDMA system and is shown in functional block diagram form in FIG. 6, while its component parts and their operation are further detailed in FIGS. 7 through 51. It performs the following principal functions: (1) converting the sequence of uplink transmission bursts into a continuous downlink PCM transmission format, inserting system control commands as required, (2) sequentially interrogating terminals for initial call requests, (3) providing inactive data terminals participating in a call with initial synchronization, (4) assigning time slots to data terminals upon demand, (5) maintaining synchronization of all active data terminals in the system, (6) providing initial call commands to all inactive terminals being called, (7) providing called subscriber addresses to called terminals, (8) accepting call requests from active terminals, (9) providing "all circuits busy" commands when all repeater time slots are full, and (10) initializing the system upon ground command or upon power turn-on.

**CLPR:**

1. In a time division multiple access communication system having a plurality of data terminals, each terminal capable of transmitting an uplink burst of data within an assigned time slot, and all capable of receiving an essentially continuous stream of downlink data, a processing repeater for receiving a burst transmission from one of said data terminals and for transmitting it within a frame of said stream of data to another of said terminals, said processing repeater comprising:

**WEST****Freeform Search****Database:**

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 Derwent World Patents Index  
 IBM Technical Disclosure Bulletins

**Term:**

12 same (repeater\$)

**Display:**

62

**Documents in Display Format:**

TI

**Starting with Number**

1

**Generate:** ☐ Hit List ☒ Hit Count ☐ Image

Search

Clear

Help

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Interrupt

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**Search History****Today's Date:** 1/10/2001

<u>DB Name</u>	<u>Query</u>	<u>Hit Count</u>	<u>Set Name</u>
USPT,JPAB,EPAB,DWPI,TDBD	12 same (repeater\$)	45	<u>L4</u>
USPT,JPAB,EPAB,DWPI,TDBD	11 and 12	57	<u>L3</u>
USPT,JPAB,EPAB,DWPI,TDBD	assign\$4 near (time adj slot\$)	3747	<u>L2</u>
USPT,JPAB,EPAB,DWPI,TDBD	repeater\$ and ((base near station\$) or (base near unit\$)) and (subscriber\$ or mobile\$ or cellular\$)	1345	<u>L1</u>

**WEST**

Generate Collection

L4: Entry 29 of 45

File: USPT

Dec 25, 1984

DOCUMENT-IDENTIFIER: US 4490818 A

TITLE: Repeater station for use in a radio relay system to protect time deviations of time slots

## BSPR:

Each of conventional repeater stations is operable in response to a time division multiple signal which is arranged in a succession of time slots assigned to the substations carrying out communication. Such a time division multiple signal is supplied to each repeater station from an upper station and from a lower station situated upstream and downstream relative to each repeater station through various repeated paths, respectively. The upper station may be either the central station or another repeater station while the lower station, either a further repeater station or one of the substations.

## DEPR:

In FIG. 2, it is to be noted that the specific repeater station 13-1 is supplied with the time division multiple signals through various kinds of transmission paths and that each time slot is assigned common to the respective substations 12. This means that each time slot received at the specific repeater station 13-1 is individually variable or fluctuated from one another in dependency on the transmission paths, as will be described in detail.

## DEPR:

Although the above-mentioned discussion has been directed to the particular downward and the particular upward time slots, this applies to the other time slots. With the repeater station, it is possible to protect each time slot from being individually varied from one another by the use of the memory section for memorizing the signals in each address block assigned to each time slot and for reading the memorized signals out of each address block. Anyway, the central station 11 can receive the signals without superposition of each time deviation occurring between two adjacent stations.

**WEST**☐ Generate Collection

L3: Entry 53 of 57

File: USPT

Dec 15, 1987

DOCUMENT-IDENTIFIER: US 4713809 A

TITLE: Time division multiple access radio communications system

## ABPL:

In a time division multiple access radio communication system constituted by a plurality of repeater stations and a plurality of terminals, only when the time slot in both the upward and downward directions is identical in a repeater station, the repeater station repeats data in the time slot. Downward data of a time slot used by a subscriber in an upward zone is not repeated to downward repeater stations, thereby saving power.

## BSPR:

The present invention relates to a Time Division Multiple Access (TDMA) radio communication system and, more particularly, to a repeater station in the TDMA radio communication system.

## BSPR:

A system of this type is normally constituted by an exchanger connected to a plurality of subscribers, a base station which is connected to the exchanger and has a radio transmitter/receiver so as to link the radio subscribers within its service zone (home zone) with the exchanger, and a plurality of repeater stations which have individual home zones and provides repeater services to the radio subscribers within the corresponding home zones. The repeater station closer to the base station is referred to as a "higher" repeater station towards the others, and the repeater station at longer distance from the base station than others is referred to as a "lower" repeater station towards the others.

## BSPR:

Each repeater station has a downward receiver for receiving a downward signal from the higher repeater station, a downward transmitter for transmitting the downward signal to the lower repeater station, an upward receiver for receiving an upward signal from the lower repeater station, and an upward transmitter for transmitting the upward signal to the higher repeater station.

## BSPR:

Communication between subscribers is time-divisionally performed, and at least one time slot is assigned to one communication (single speech or data).

## BSPR:

Conventionally, when a radio subscriber in the home zone of a higher repeater station communicates with a subscriber connected to the exchanger via the base station, the downward transmitter of the higher repeater station is operated over all the time slots. More specifically, even though a subscriber in the home zone of a lower repeater station does not perform communication, a downward transmitter of the higher repeater station is driven, thus wasting power.

## BSPR:

It is an object of the present invention to provide a TDMA radio communication system which is free from the conventional drawbacks, and can reduce power consumption in repeater stations.

## BSPR:

According to the present invention, there is provided a TDMA radio communication system comprising: one base station; a plurality of repeater stations for sequentially repeating a radio signal received by and transmitted from the base station; and a plurality of terminals for communicating the radio signal with the base station via the repeater stations, each of the repeater stations including repeater means for repeating the radio signal using a time slot assigned to each of the terminals, wherein each of the repeater stations further comprises means

for detecting a time slot in upward communication, and means for activating the repeater means in association with only a time slot in downward communication corresponding to the detected time slot in upward communication.

DEPR:

FIG. 5 is a block diagram showing an arrangement of a repeater station shown in FIG. 1; and

DEPR:

FIG. 1 is a block diagram for explaining the overall arrangement of a TDMA communication system according to the present invention. This system can serve for 128 radio subscribers.

DEPR:

Referring to FIG. 1, a plurality of subscriber's telephones 1 are connected to a local exchanger 2 through corresponding subscriber's lines. The local exchanger 2 is connected to a base station 4 through a DRCS (Digital Radio Communication System) exchanger 3. The base station 4 has a transmitter/receiver, and can provide services to 42 radio subscribers 4'-1 to 4'-42 within a home zone A. The base station 4 is radio-connected to a distant repeater station 5 (to be described later). The repeater station 5 has a home zone B and can provide services to 43 subscriber's radio terminals 5'-1 to 5'-43 within the home zone B. The repeater station 5 is radio-connected to another repeater station 6, which can provide repeater services to 43 subscriber's radio terminals 6'-1 to 6'-43 within its home zone C. Each of the repeater stations 5 and 6 has an upward transmitter, an upward receiver, a downward transmitter, and a downward receiver including antennas. In this instance, the repeater stations 5 and 6 are higher and lower repeater stations, respectively.

DEPR:

Each radio subscriber in the home zone A, B, or C is connected with the repeater station in the corresponding home zone.

DEPR:

FIG. 5 shows the arrangement of the repeater station 5 in the system shown in FIG. 1.

DEPR:

The operation of the repeater station 5 shown in FIG. 5 will now be described.

DEPR:

The timing circuits 25.sub.1 to 25.sub.n produce "H" output signals as follows. The reception data from the downward repeater station 6 (FIG. 1) is input to the serial-to-parallel converter 21, and the outputs therefrom are respectively supplied to the start code detectors 22.sub.1 to 22.sub.n and the memories 23.sub.1 to 23.sub.n. When the upward reception squelch signals and the start codes are detected, the outputs from the AND gates 24.sub.1 to 24.sub.n corresponding to the respective time slots go to "H" level. Then, data from the memories 23.sub.1 to 23.sub.n are transmitted from the upward transmitter 40 through the parallel-to-serial converter 26. At the same time, the "H" outputs from the AND gates 14.sub.1 to 14.sub.n are also supplied to the corresponding timing circuits 25.sub.1 to 25.sub.n, and the "H" signals are supplied from the timing circuits 25.sub.1 to 25.sub.n to the third input terminals of the corresponding AND gates 14.sub.1 to 14.sub.n. More specifically, the repeater station 5 monitors both the upward and downward start codes, and repeats the downward data only for the time slot in which both the upward and downward start codes are detected.

DEPR:

FIG. 6 shows the operating state of the downward transmitter 30 in the higher repeater station 5 during communication of the lower repeater station 6. As can be seen from FIG. 6, the transmitter 30 of the repeater station 5 is turned on only in the time slots TS11 to TS15 which are assigned to the home zone C of the repeater station 6, and is turned off in other time slots TS1 to TS10. Therefore, power consumed by the transmitter 30 is expressed by:

DEPR:

About 20% to 25% of total power is expected to be saved when considering power consumed by the upward and downward transmitters/receivers, a control panel, and

the like mounted on the repeater station.

DEPR:

As can be understood from the above embodiment, the present invention is very effective to reduce the power consumption of the higher repeater stations when a large number of repeater stations are installed.

CLPR:

2. A system according to claim 1, wherein said repeater means comprises memory means for storing upward and downward reception signals; means for detecting a time slot in use; means for controlling a readout operation of said memory means corresponding to the detected time slot; and means for transmitting the output from said memory means.

CLPR:

3. A system according to claim 2, wherein said means for activating said repeater means comprises a timing circuit for generating a control signal in accordance with the output from said time slot detecting means for detecting a time slot in upward communication, and means for enabling the output from said memory means in accordance with the control signal.

CLPV:

one base station;

CLPV:

a plurality of repeater stations for sequentially repeating a radio signal received by and transmitted from said base station; and

CLPV:

a plurality of terminals for communicating the radio signal with said base station via said repeater stations,

CLPV:

each of said repeater stations including repeater means for repeating the radio signal using a time slot assigned to each of said terminals, wherein

CLPV:

each of said repeater stations further comprises means for detecting a time slot in upward communication, and means for activating said repeater means in association with only a time slot in downward communication corresponding to the detected time slot in upward communication.